1.0 INTRODUCTION

This report, *The Initial Surface Water Quality Watershed Characterization and Assessment Report for the Monmouth County Watershed Management Area (WMA #12),* represents an initial step in the watershed management planning process that summarizes existing information related to surface water quality in WMA #12 that was readily available to the Department. This report serves two main purposes: 1) it is a preliminary step towards developing a comprehensive watershed characterization and assessment report for the WMA #12; and 2) it compiles preliminary information to help define a set of surface water quality issues including the development of Total Maximum Daily Loads (TMDLs) for the impaired waters within WMA #12.

This Surface Water Quality Characterization Report relies on information readily available to the Department and was gathered from published reports, ambient and site-specific monitoring data, and our geographic information system (GIS). Regulatory and other program reports and databases were used to generate maps and summarize "contributing factors" information. Subsequent to this report, emphasis will be placed on identifying and integrating other data sets (including stakeholder data) through the ongoing watershed management planning process. It is expected that additional information will be required to complete the analysis, including monitoring, modeling, and a more refined assessment of potential contaminant loads. The report makes extensive use of GIS maps in conveying surface water quality characterization data (e.g. point and nonpoint sources of pollution, known contaminated sites, roads, population, and pesticide applications) as deemed appropriate.

This Surface Water Quality Characterization and Assessment Report is the surface water quality component of a much broader assessment to be provided in a subsequent Watershed Characterization and Assessment Report for WMA #12. The Watershed Characterization and Assessment Report will include new and additional data, findings and other contributions from the Department and the WMA #12 stakeholders, and will comprehensively address watershed issues such as ground water and drinking water quantity, land and living resources, contributing factors, existing and planned management measures, and data management/data assessment needs. The expanded report will be viewed as a "living document" and will be expected to change over time based on continued input from WMA #12 stakeholders. Such changes will serve as part of the iterative planning cycle. In the future, an INTERNET version of this and other related documents will be made available to the general public as a Watershed Webpage.

1.1 BACKGROUND

New Jersey's watershed management approach relies on sound science and a collaborative stakeholder process to protect, maintain and improve the water resources of the state. In order to achieve this goal, the New Jersey Department of Environmental Protection (Department) intends to employ a collaborative planning process by which government agencies and the watershed community can work together to identify and address water resource issues and concerns on a geographic basis. The development of a watershed characterization and assessment report is one of the first steps in this collaborative planning process. Watershed characterization and assessment will enable the Department and the stakeholders to target and prioritize watershed issues to be addressed through the watershed management process. Data gaps identified during this phase may require new monitoring and modeling efforts to both verify current water resource trends; to project future trends; and to identify water resource issues, problems and pollution sources.

The resulting detailed watershed characterization and assessment will identify a set of priority issues of concern for each watershed management area (WMA), to be addressed by the watershed management area plan (WMAP). To facilitate efficient compilation of characterization and assessment information and to mange resources in the planing process DEP has partitioned the State into twenty WMAs (See Figure 1.1-1). Specific water resource goals and measurable environmental objectives (e.g. specific percent reduction in pollutant loading, or elimination of projected water supply deficits, over a specified time period) will be developed for each issue. In certain watershed management areas, watershed goals will be formalized through the development of Total Maximum Daily Loads (TMDLs). TMDLs represent the assimilative or carrying capacity of the receiving water, taking into consideration point and nonpoint sources of pollution, as well as surface water withdrawals and ground water and atmospheric deposition impacts on receiving waters. TMDLs are an important planning tool, since they can be used to explore different load allocation strategies and to reserve future capacity of receiving water in order to meet certain watershed protection goals.

Where TMDLs are required to address documented surface water quality impairment; a TMDL is developed as a mechanism for identifying all the contributors to surface water quality impacts and for setting goals for load reductions for specific pollutants as necessary to meet surface water quality standards. Allocations are made to the varying sources contributing to the water quality problem in order to reduce the total pollutant load received by the waterbody. Load reduction goals established through TMDLs are achieved through the issuance of wasteload allocations (WLAs) for points source discharges, load allocations (LAs) for nonpoint source discharges, and water allocations for surface water withdrawals.

In some watershed management areas, TMDLs may still be required even though the receiving waters are predominantly impacted by nonpoint source pollution. In such cases, the TMDL would consist mainly of the load allocation for the major categories of nonpoint source pollution contributors along with an implementation plan for best management practices (BMPs) for stormwater management and nonpoint source pollution control, headwaters protection practices, or other mechanisms for addressing the priority issues of concern.

The Watershed Characterization and Assessment Report for WMA #12 will ultimately provide the scientific basis for establishing a planning baseline that will be used by the Department and the WMA #12 Public Advisory Committee to identify and prioritize issues of concern and to establish environmental goals and objectives for the watershed management area. It will serve as a technical support document for the watershed management area plan, which will identify regulatory and non-regulatory management measures, responsibilities and funding needed to attain the environmental goals and objectives. The watershed management area plan will include: a summary of the baseline information; water resources trends and priority concerns; watershed goals and objectives; selected management strategies, including pollution trading agreements as appropriate; and implementation responsibilities and schedules.

Active involvement of watershed stakeholders is essential to the successful development of a watershed management plan. A partnership is being formed in WMA #12 that includes representatives of federal, state, regional, and local agencies, academics, citizens, business and industry, water purveyors, dischargers, agriculturists, environmental and public interest groups. The Public Advisory Committee and subcommittees will provide a formal avenue for this partnership to work with the Department on expanding and refining this initial Surface Water Quality Characterization Report into a comprehensive Watershed Characterization and Assessment Report through the watershed management planning process.

In presenting this report, the Department recognizes that the preliminary data and findings presented here are incomplete and need to be expanded and refined through a collaborative stakeholder process. However, by compiling and evaluating the Department's own database for information and trends pertinent to the surface water quality issues in WMA #12, the Public Advisory Committee will have the information with which to begin implementing the watershed management approach presented in the *Draft Statewide Watershed Management Framework Document for the State of New Jersey* (January 1997).

2.0 SETTING: NATURAL AND BUILT LANDSCAPE

2.1 Location

Figure 2.1-1 depicts the 57 municipalities (and portions of three counties) that lie entirely or partially within the WMA #12 boundary. The area and population density for each municipality is provided in Table 2.1-1 in Appendix 1. WMA #12 includes watersheds (Figure 2.1-2) that primarily drain the eastern portions of Monmouth County and flow in one of two directions: northeast to Sandy Hook/Raritan Bay or southeast to the Atlantic Ocean.

WMA #12 includes 503 square miles (7.0% of New Jersey land surface) and at the widest points is approximately 23 miles long and 18 miles wide. WMA #12 lies in the Coastal Plain physiographic province (See Figure 2.1-3) with a low-lying topography (e.g., typically no greater than 100 feet above sea level). All of the WMA #12 streams and rivers are tidally influenced usually to the first dam or impoundment above the confluence (Figure 2.1-4). Sandy soils and coastal scrub/pine vegetation dominate WMA #12 (i.e., the coastal plain) which strongly influences any hydrologic characteristics. In addition, a depicted in Figure 2.1-4, the downstream segments of all the WMA #12 streams and rivers lie within the jurisdiction of the Coastal Area Facility Review Act (CAFRA) management zone (N.J.S.A. 13:19-1 et seq. - as amended July 19, 1993).

2.2 Surface Water Hydrology and Water Classifications

WMA #12 includes the following major watersheds (See Figure 2.1-2):

Raritan/Sandy Hook Bay Tributaries	Navesink River	Shrewsbury River
Shark River	Manasquan River	Wreck Pond Brook

The southeast watersheds (i.e., the Shark and Manasquan Rivers) drain directly into the Atlantic Ocean. The northeast watersheds may drain directly into Raritan Bay or indirectly by way of Sandy Hook Bay (i.e., the Shrewsbury and Navesink Rivers). For example, Matawan Creek and a number of smaller streams flow directly into Raritan Bay, including:

Chingarora Creek	Comptons Creek	Pews Creek
East Creek	Flat Creek	Luppatcong Creek
Many Mind Creek	Matawan Creek	Thorns Creek
Waackaack Creek	Wagner Creek	Ware Creek
Whale Creek		

2.2.1 Navesink River

The Navesink River drains an area of 95 square miles. Tributaries to the Navesink include the Swimming River, Yellow Brook, Big Brook, Mine Brook, and Willow Brook. The Swimming River Reservoir (i.e., a major potable water impoundment) is located in this watershed, as are many small ponds. The waters in this region have been classified FW-2 Trout Maintenance, FW-2 Nontrout and SE-1. The Navesink estuary supports substantial hard clam (Mercenaria mercenaria) and soft clam (Mya arenaria) populations. Shellfish Classification Areas for the Navesink River (Figure 2.2-1) include both Special Restricted waters and Seasonal waters (i.e., November to April).

2.2.2 Shrewsbury River

The Shrewsbury River drains an area of 27 square miles. Tributaries to the river include Manhassett Creek, Troutman’s Creek, Branchport Creek, Turtle Mill Brook, Parkers Creek, Oceanport Creek, Town Neck Creek, Wardell’s Creek and Little Silver Creek. Franklin Lake lies in this area, as do many small ponds. The waters in this region have been classified FW-2 Trout Maintenance, FW-2 Nontrout and SE-1. The Shrewsbury estuary supports substantial hard (Mercenaria mercenaria) and soft clam (Mya arenaria) populations (Figure 2.4-1). As stated above, the Shrewsbury and adjoining Navesink Rivers produce almost the entire soft clam fishery for New Jersey. Shellfish Classification for the Shrewsbury River (Figure 2.2-1) is Special Restricted.

2.2.3 Shark River

The Shark River drains an area of 23 square miles. A tributary to the river is Jumping Brook (7 miles long). The Shark River Watershed includes not only the Shark River but also a regional collection of nearby streams most of, which are impounded near their mouths to form coastal ponds before draining into the Atlantic Ocean. Surface waters in this watershed include:

- Hankins Brook
- Hannabrand Brook
- Hog Swamp Brook
- Polly Pod Brook
- Poplar Brook
- Shark River
- Whale Pond Brook
- Wreck Pond Brook

Prominent lakes and coastal ponds in this watershed include:

- Como Lake
- Deal Lake
- Fletcher Lake
- Spring Lake
- Takanassee Lake
- Sylvan Lake
- Wesley Lake
- Wreck Pond

The waters in this region have been classified FW-2 Trout Maintenance, FW-2 Nontrout and SE-1. Shellfish Classification for the Shark River (Figure 2.2-1) is Special Restricted.

2.2.4 Manasquan River

The Manasquan River drains an area of 81 square miles and flows for 23 miles south-easterly from Freehold Township in Central Monmouth County to the Manasquan Inlet (i.e., Atlantic Ocean) on the Ocean/Monmouth County line. The headwaters flow from a rural/agricultural area to the densely populated shore. The Manasquan River, in its lower reach, is connected to Barnegat Bay through the Point Pleasant Canal (i.e., a major thorofare for boat traffic). The major tributaries include Debois Creek, Mingamahone Creek and Marsh Bog Brook. The Manasquan River is tidally influenced up to a point approximately two miles east of the Garden State Parkway (See Figure 2.1-4). The waters are classified FW-1, FW-2 Trout Maintenance, FW-2 Nontrout and SE-1. Shellfish Classification for the Manasquan River (Figure 2.2-1) is Special Restricted up to the Route 70 Bridge and Prohibited for all waters above the same bridge.

There are a number of small lakes and ponds, most of which are used for recreational purposes. The Manasquan Reservoir (i.e., a major potable water impoundment) is a pump-storage reservoir situated off the mainstem Manasquan River. It is fed by pumps and pipeline withdrawing water from the Manasquan at peak flow periods for subsequent release during low flow conditions.

2.3 Land Use

Land use and land covers for WMA #12 are shown on Figure 2.3-1. These digital land use data were generated from 1986 aerial photogrammetry. NJDEP has issued a contract to update land use and land cover data statewide using 1993/95 overflights. This work is expected to be completed in 2000. The primary land use classifications in WMA #12 (as of 1986) include: 49% built land, 28% forested, 13% agricultural, 7% wetlands, 2% barren lands and 1% water.

2.3.1 Urban or Built (up) Lands

The Level 1 Urban or Built-up Land category is characterized by intensive land use where the landscape has been altered by human activities. Although structures are usually present, this category is not restricted to traditional urban areas. Urban or Built-up Land Level II categories include Residential; Commercial and Service; Industrial; Transportation, Communication and Utilities; Industrial and Commercial Complexes; Mixed Urban or Built-up; Other Urban or Build-up and Recreational. Included with each of the above land uses are associated lands, buildings, parking lots, access roads, and other appurtenances, unless these are specifically excluded.

2.3.2 Forest

This Level I category contains any lands covered by woody vegetation other than wetlands. These areas are capable of producing timber and other wood products, and of supporting many kinds of outdoor recreation. Forestland is an important category environmentally, because it affects air quality, water quality, wildlife habitat, climate, and many other aspects of the ecology of an area. The Level II categories under Forestland are Deciduous; Coniferous; Mixed Deciduous-Coniferous; and Brushland.

2.3.3 Agricultural

This Level I category includes all lands used primarily for the production of food and fiber and some of the structures associated with this production. These areas are easily distinguished from the other categories and represent a significant land use in New Jersey. The Level II categories of Agricultural Land are; Cropland and Pastureland; Orchards; Vineyards; Nurseries and Horticultural Areas; Confined Feeding Operations; and Other environmental concern because of the non-point source pollution associated with confined feeding operations.

2.3.4 Wetlands

The wetlands are those areas that are inundated or saturated by surface or ground waters at a frequency and duration sufficient to support vegetation adapted for life in saturated soil conditions. Included in this category are naturally vegetated swamps, marshes, bogs and savannas which are normally associated with topographically low elevations but may be located at any elevation where water perches over an aquiclude. Wetlands that have been modified for recreation, agriculture, or industry are not included but described under that specific use category. The wetlands of New Jersey are located around the numerous interior stream systems, and along our coastal rivers and bays. New Jersey, by its numerous different physiographic regions, supports various wetland habitats dependent upon physiographic and geological variables. The Level II classification separates wetlands into two categories based on the location relative to a tidal water system.

2.3.5 Barren Lands

Barren lands are characterized by thin soil, sand or rocks and a lack of vegetative cover in a non-urban setting. Vegetation, if present, is widely spaced. Barren land such as beaches and rock faces are found in nature but also result as a product of man's activities. Extraction mining operations, landfills and other disposal sites compose the majority of man-altered barren lands.

2.3.6 Water

All areas within the landmass of New Jersey, periodically covered by water, are included in this category. All waterbodies are delineated as they existed at the time of data acquisition, except areas in an obvious state of flood. Level I includes four (4) Level II categories; Streams and Canals; Natural Lakes; Artificial Lakes; and Bays and Estuaries. Not included in this category are water treatment and sewage treatment facilities.

2.4 Population

Figure 2.4-1 and Table 2.1-1 contrast WMA #12 municipal information for 1980 and 1990 including population densities (i.e., number of people per square acre). Population density is usually a good indicator of potential human stress on the lands and waters of an environment. In both 1980 and 1990 population density for WMA #12 appears greatest in the northwestern municipalities fronting Raritan Bay and the eastern Atlantic coastal municipalities. Population density is less to the west (i.e., headwaters) in more forested and agricultural areas (Figure 2.3-1). In Table 2.1-1 population density changes (i.e., between 1980 and 1990) are summarized as indicators of potential increasing/decreasing stress to associated watersheds. Based on these data it appears that most municipal population densities have fluctuated only slightly between 1980 and 1990 whereas a few have had added significant numbers of individuals/sq.mi. over the same period of time. The implications of these density changes are unclear at this time but shall be addressed as part of the full watershed characterization, assessment and management process.

3.0 SURFACE WATER QUALITY CONCERNS

3.1 Surface Water Quality Monitoring

Monitoring data are used to establish baseline conditions, determine trends, and identify solutions to or further study water quality problems. The NJDEP's primary surface water quality monitoring unit is the Office of Water Monitoring Management, although monitoring functions are also performed by other units (NJDEP 1998). The DEP and the United States Geological Survey (USGS) have cooperatively operated the Ambient Stream Monitoring Network (ASMN) in New Jersey since the 1970s. The data from this network have been used to assess the quality of freshwater streams and sediments. Although the network was sufficient to assess general status and trends, changes were needed to provide data for water quality indicators and watershed management. Therefore, a new network was designed by a DEP/USGS interagency committee which has been operating since the fall of 1997 (See Appendix 3 (a.). Data reported here were collected prior to the implementation of the redesigned Ambient Stream Monitoring Network.

3.1.1 Monitoring Stations

3.1.1.1 Ambient Stream Monitoring Network (ASMN - Freshwater)

ACTIVE
There is one active water quality monitoring station currently operating in WMA #12.

Station Name	Classification
Manasquan River at Squankum	FW-2 Trout Maintenance

DISCONTINUED
Discontinued ASMN Monitoring Stations (as of 1991) include:

Shark River Stations	Classification
Jumping Brook near Neptune City	FW-2 Nontrout
Shark River near Neptune	FW-2 Trout Maintenance

Manasquan River Station	Classification
Marsh Bog Brook at Squankum	FW-2 Nontrout

3.1.2 Ambient Stream Monitoring Network (ASMN) Results

As stated above, WMA #12 includes one ASMN station that is on the Manasquan River at Squankum (Figure 3.1-1). Routine water column parameters and observations taken this monitoring station 5 times per year include:

water temperature	flow-gage readings	weather conditions
dissolved oxygen	pH	specific conductance
biological oxygen demand (BOD) #	suspended solids	total phosphorus *

chemical oxygen demand (COD) #	fecal coliform bacteria	enterococus bacteria
total Kjeldahl nitrogen (TKN)*	Chloride	Fluoride
inorganic nitrogen (nitrite + nitrate)*	Magnesium	Potassium
total organic carbon (TOC)	Silica	Sulfate
Calcium	Sodium	

Notes: # monitored at selected sites
* Total and dissolved fractions analyzed to facilitate understanding cycling and transport

Supplemental water column parameters, monitored 2 times per year, include:

Sulfide	Total Hardness	Beryllium	Boron
Arsenic	Lead	Selenium	Mercury
Cadmium	Chromium	Copper	Iron
Manganese	Nickel	Zinc	Aluminum
Phenol			

Supplemental sediment parameters, monitored once every 3 years, include metals, organic pesticides and PCBs.

3.1.3 Ambient Biomonitoring Network (AMNET)

Ambient chemical monitoring is now extensively supplemented by biological assessments of in-stream benthic macroinvertebrate communities. These communities are examined using USEPA's Rapid Bioassessment Protocols (USEPA 1989). From this, evaluations regarding the overall health of instream biota are estimated and in so doing, are categorized as nonimpaired, moderately impaired and severely impaired (Figure 3.1-1). These biological assessments are useful in evaluating aquatic life designated use, as well as revealing the impact of toxic contaminants, and detecting chronic water quality conditions which may be overlooked by the short-term "snapshot" view provided by ambient chemical sampling.

3.1.4 Estuarine/Marine Water Quality Monitoring

In the estuarine and marine areas of the State a series of Monitoring Programs are also in place (NJDEP 1998) to address a range of environmental and public health issues including: shellfish sanitation (e.g., bacteria), water quality (e.g., nitrate), phytoplankton (e.g., paralytic shellfish poison/low DO), and bathing beaches (e.g., fecal coliforms). In 1997 NJDEP developed a new approach for a Nonpoint Source (NPS) monitoring strategy for New Jersey's coastal zone (Connell 1997) based on federal guidance documents: NOAA's Guidance for Nonpoint Pollution in Coastal Waters (NOAA, 1993) and EPA's Nonpoint Source Monitoring and Evaluation Guide (USEPA, 1996). The proximate objectives of the monitoring (NOAA 1993) were to: (1) assess changes in pollution loads over time; (2) to assess changes in water quality over time; (3) to identify potential nonpoint sources of pollution; and (4) to measure the success of BMP implementation.

Existing estuarine watershed-based monitoring programs in New Jersey are summarized in Appendix 3(b). They include:

Monitoring Program	Focus
National Shellfish Sanitation Program (NSSP)	Food Fish
Estuarine Monitoring Program	Algal Blooms
Phytoplankton Monitoring Network	Paralytic Shellfish Poison
Coastal Cooperative Monitoring Network	Bathing Beaches

Management Measurements	Focus
Sewage Infrastructure Improvement Act (SIIA)	Stormwater/Sewage Outfalls
Combined Sewer Outfalls (CSOs)	CSO Abatement

3.2 Surface Water Quality Standards

Water quality standards establish the water quality goals and policies underlying the management of the state's waters. These standards designate the use or uses to be made of the water and then set criteria and policies necessary to protect the uses, as well as the existing higher quality of many waters. In establishing water quality standards, the first step is to determine the water uses to be protected. The second step is to establish criteria based on sound scientific data to protect the designated uses. States are required to adopt water quality standards that will protect both the existing and designated uses of a waterbody with an adequate degree of safety. The most recent modifications to the New Jersey Surface Water Quality Standards were proposed and formally adopted in 1997 (See Appendix 1, Table 3.2-1). Among the most significant changes were numeric criteria for toxic and hazardous substances, a definition for wetlands which will act as an initial step toward developing Surface Water Quality Standards for wetlands, and modifications to stream classifications based upon newly acquired information on trout streams.

3.3 Chemical and Pathogenic Evaluation of Surface Water Quality

Surface water quality information was based primarily on data assessments conducted for the *1996 New Jersey State Water Quality Inventory Report* (NJDEP, 1998). Data collected through the Ambient Stream Monitoring Network and USGS's NASQAN Program are summarized and compared to applicable Surface Water Quality Standards numerical criteria. Summary results and numerical criteria are shown in Appendix 1, Tables 3.3-1 and 3.3-2. Comparisons to numerical criteria for nutrients and oxygen parameters are not problematic because concentrations are in the "parts per million" range and concentrations at or near the minimum detectable concentration (MDL) are not common. The MDL is the minimum concentration that a laboratory can routinely measure and is specific to the parameter, sample type and analysis method.

Analysis of metals data is more complex. Concentrations and numerical criteria are in the "parts per billion" range, requiring very careful sample collection and analysis procedures and very sensitive analytical methods.

Numerical criteria for metals include criteria to protect aquatic life from potential detrimental effects of short-term (acute) and long-term (chronic) exposure and to protect human health from potential detrimental effects of exposures through drinking water and/ or consumption of fish. Therefore, for each metal, 1 to 3 numerical criteria apply.

The dissolved salts in water, measured as water hardness, changes the effects that some metals may have on aquatic life. (Human health criteria are not affected by water hardness). Aquatic life criteria for cadmium, copper, lead and zinc are calculated for each sample based on the hardness of the water at the time of sampling. As hardness decreases, calculated acute and chronic aquatic life criteria for metals also decrease. Acute and chronic aquatic life criteria for arsenic, chromium, and mercury for are not affected by the hardness of the water.

The numerical criteria and metals concentrations in the water are often quite low. This is problematic because the numerical criteria and stream concentrations of metals are often near or even below the MDL. Data quality for metals data has also been a concern in New Jersey and nationwide. Because the concentrations of interest are very low (parts per billion range), even small amounts of sample contamination, for example, from sampling equipment, during transportation etc., can significantly affect the results. NJDEP and USGS have improved sample collection methods subsequent to this reporting period. Therefore, the results presented below for potential exceedances of numerical criteria indicate the need for additional sampling using improved sample collection techniques. Sample results below the criteria can reliably convey attainment of SWQS numerical criteria.

The metals data assessment summarized below included:

- Stream concentration data were compared to the MDL.
- Numerical criteria were calculated as needed based on the water hardness at the time of sampling
- Samples above the MDL were compared to applicable numerical criteria at the time of sampling
- Samples above the MDL and above the criteria indicate the need for additional sampling; samples at or above the MDL and below the criteria indicate attainment of the criteria.

3.4 Fresh Water Quality Assessments

3.4.1 Manasquan River

3.4.1.1Ambient Surface Water Monitoring Network

Location: Manasquan River (Squankum)
SWQS Classification: FW-2 Trout Maintenance
Dissolved Oxygen: Acceptable.
Temperature: One violation (of 18 samples) of the upper criterion for trout maintenance waters.

Nutrients:

Total Phosphorous: Total phosphorous is acceptable, with only 2 of 18 samples exceeding the criterion of 0.10 mg/l. The median value was 0.055 mg/l.

Nitrate: Inorganic nitrogen is acceptable; the median value is 0.52 mg/l with no values greater than 0.89 mg/l.

Bacteria: Moderate bacterial levels were recorded at Squankum. The geometric mean was 217 MPN/100 ml, with 33% of samples exceeding the 400/100ml criterion.

Heavy Metals: One copper sample approached but did not exceed the chronic criteria for aquatic life support. One of the seven lead records exceeded the chronic criteria for aquatic life support for lead. Elevated levels of lead, zinc, and mercury have been detected within the sediments of the Manasquan (NJDEP, 1990).

Summary:

Freshwater: Within the freshwater portions of the Manasquan, nutrients and dissolved oxygen levels are acceptable. Instream temperatures, however, are high, with several readings approaching or exceeding 20^{o} C. Lead and possibly copper within the water column may impair aquatic life support at Squankum. Studies have found elevated lead, zinc, and mercury within the sediments of the Manasquan River (NJDEP, 1990). Sanitary quality is marginally poor.

Estuarine: Within the Manasquan River estuary, low summertime dissolved oxygen levels (sometimes below the 4.0 mg/l criterion for SE 1 waters) are reported by the Monmouth and Ocean County Health Departments (Monmouth-Ocean County, 1996). Sanitary quality is poor here also, causing the upper portions of the estuary to be condemned for shellfish harvesting (i.e., above the Rt. 70 Bridge) and the mid- to lower portions to be classified as Special Restricted for harvesting.

3.4.1.2 Ambient Biological Monitoring Network

Macroinvertebrate analyses indicate mostly moderately impaired stations in the Manasquan watershed (Figure 3.1-1 and Table 3.4-1) with one severely impaired station at Debois Creek in Freehold Township. Three stations showed no impairment (i.e., Stan and Squankum Brooks in Howell Township and the lower portion of Mingamahone Brook in Squankum).

Evaluation of Water Quality in Lakes: Trophic Status
No information available at this time.

Contamination in Fish Tissue
Manasquan Reservoir - Mercury.

3.4.2 Shark River

Prior to 1991 and through the second half of the 1980s there were two ambient monitoring stations collecting physical/chemical data within these watersheds - Jumping Brook near Neptune City (FW-2 Nontrout) and Shark River near Neptune (FW-2 Trout

Maintenance). During that time period, monitoring found water quality to be excellent and good in Jumping Brook and the Shark River, respectively.

Bacteria: The only water quality indicators found at problematic levels in Jumping Brook were occasional (25 percent) fecal coliform counts greater than 200 MPN/100ml. In the Shark River, nutrient and fecal coliform levels were slightly higher than in Jumping Brook. Fecal coliform levels had a geometric mean of 121 MPN/100ml, with 39 percent of samples greater than 200 MPN/100ml.

Nutrients: Total phosphorus was above the 0.1 mg/l criterion in 13 percent of the samples collected.

Dissolved oxygen: DO was sufficient throughout the year in the two streams.

pH: Both streams are moderately acidic.

Biological Evaluation of Stream Water Quality (Benthic Macroinvertebrate Populations)

Biological monitoring within the Shark River watershed indicates either moderate to severe impairment throughout the freshwater portions of the watershed. No monitoring locations were observed to be non-impaired.

Evaluation of Water Quality in Lakes: Trophic Status

Deal Lake has been impaired since the 1950s due to sedimentation, poor sanitary quality and excessive aquatic macrophyte and algae growth. A 1983 study indicated that overland runoff is responsible for most of the sediment and nutrients.

Contamination in Fish Tissue

No information available at this time.

3.4.3 Navesink – Shrewsbury Rivers (Estuary)

Within the shellfish harvesting portions of the Navesink River the major pollution problem is high bacterial loadings from nonpoint sources. The highest concentrations occur in the segment of the river near Red Bank (NJDEP, 1993). Water quality steadily improves as one proceeds downstream until conditions are acceptable at the lower third of the river. The poorest sanitary quality is observed during the summer, especially following a rainfall. Substantial improvements in water quality in the Navesink River have occurred within this region during the late 1980s and early 1990s as a direct result of reductions of nonpoint source loadings. For the first time in 25 years, the potential now exists for unrestricted shellfish harvesting within the assessed shellfish harvesting waters of the Navesink. Biological monitoring within the Navesink watershed indicates either moderate to severe impairment throughout the freshwater portions of the watershed (Figure 3.1-1). No monitoring locations were observed to be non-impaired.

Evaluation of Water Quality in Lakes: Trophic Status

No information available at this time.

Contamination in Fish Tissue

No information available at this time.

3.4.4 Raritan-Sandy Hook Bay Tributaries

No current or historical ambient water quality stations were located on these creeks.

However six AMNET Stations have been sampled in this watershed indicating severe impairment on:

- Gravelley Brook Aberdeen Twp.
- Wilksons Brook Aberdeen Twp.
- Flat Creek Hazlet Twp.
- Mahoras Brook Middletown Twp.

Moderate biological impairment has been observed on:

- Matawan Creek Matawan Boro.
- Town Brook Middletown Twp.

3.5 Estuarine Water Quality Assessments

Since 1989 NJDEP's Bureau of Water Classification and Analysis has been monitoring for key chemical parameters in the estuarine and coastal waters throughout New Jersey. The monitoring program produces high quality data on a regular basis for a number of basic parameters such as temperature, salinity, dissolved oxygen, total suspended solids (TSS), nutrients (i.e., ammonia, nitrate/nitrite, orthophosphate, and total nitrogen). In addition all sampling is performed in conjunction with coliform bacteria sampling (i.e. indicators of pathogenic organisms in water column) which is mandated by the National Shellfish Sanitation Program (NSSP). Over 200 sampling stations are located throughout New Jersey's estuaries and the Atlantic Ocean to within 4 kilometers of the coast (Figure).

Results of these monitoring activities are routinely reported by NJDEP (Connell and Messler, 1990 and Groppenbacher 1995) and summarized by location and season. Location (i.e., watershed or receiving coastal waters) is further refined in an estuarine classification scheme developed by Boynton (1982) keyed to common factors that influence phytoplankton productivity. The estuarine classification scheme categorizes similar water types as: river dominated, embayments, lagoons and fords. In New Jersey estuarine waters only two of these categories exist: river dominated and lagoons (i.e., shallow and well mixed). NJDEP modified this scheme to include: ocean, ocean near an outfall, inlet and river. The classification categories for major watersheds in WMA #12 include:

▪ River	Manasquan River
▪ Estuarine - River dominated	Raritan Bay
	Sandy Hook Bay
	Manasquan River
	Navesink River

	Shrewsbury River
▪ Estuarine – Shallow	Shark River
▪ Inlet	Manasquan Inlet
	Shark River Inlet
▪ Ocean	11 Stations along Coast

For the purposes of this report results from the NJDEP 1995 assessment (Groppenbacher 1995) will be discussed below in a broad estuary based level. Note: The Bureau of Marine Water Classification and Analysis will be releasing a new report shortly summarizing the monitoring data from 1994-1997.

3.5.1 Navesink River - Shrewsbury River (Estuary)

The Navesink Watershed drains 95 square miles of urban/suburban residential development and agricultural land. This river joins with the Shrewsbury River before entering the Atlantic Ocean through Sandy Hook Bay. The Navesink estuary contains 2,290 acres of shellfish growing waters, which support substantial commercial densities of hard clams (Mercenaria mercenaria) and soft clams (Mya arenaria) (Scro 1993). This estuary is one of only two estuaries in the state that are unique to soft clam populations.

Groppenbacher (1995) noted that the Navesink Estuary was the only other area in the State besides the Great Egg Harbor River that exhibited low D.O. concentrations (i.e., biologically stressed). Orthophosphorous concentrations were high during the summer, as were nitrogen concentrations. The majority of total organic nitrogen was organic (74%) for the upper part of the river which decreased to approximately 50% organic nitrogen in the lower river. The majority of the inorganic nitrogen was comprised of nitrate/nitrite through the year except during the summer when ammonia values were as high if not higher.

Fecal coliform bacteria concentrations in the Navesink Estuary could not be evaluated during this period (i.e., 1990-1993) due to a lack of data.

3.5.2 Raritan-Sandy Hook Bay Tributaries

No specific sampling took place within the watersheds of the Raritan-Sandy Hook Bay Tributaries sub-watershed in WMA #12. However, extensive sampling (Groppenbacher 1995) took place in the receiving waters of Raritan Bay and Sandy Hook Bay (i.e., part of the Hudson-Raritan Bay Estuary). Sampling locations were selected in the southeastern portion of the estuary (i.e., from 1.6 km north of Consokonk Point eastward into Sandy Hook Bay).

Water quality in the estuary was characterized by a frequent occurrence of oxygen supersaturation (93-133%). This reflected an average decrease in dissolved oxygen supersaturation values since data was evaluated for 1989-1990 (130-175%) by Connell and Messler (1990). However, these values are higher than anywhere else in the state except for locations near the inlet and in the ocean. In comparison to NJ's dissolved oxygen standard (i.e., ocean = not less than 0.5 mg/l and estuarine = not less than 0.4 mg/l) all stations statewide met the standards in all seasons.

Orthophosphate values were lowest in spring and winter seasons with increase in summer. Although NOAA's phosphorous standard is for total dissolved phosphorous when orthophosphate values were compared only one station was determined to be high.

The Hudson Raritan Estuary is an area that has higher values for total nitrogen when compared to the majority of the other coastal areas of the state. The summer season showed the highest value. In Raritan Bay the combined average values of inorganic nitrogen were more than twice the amount of organic nitrogen. However, in Sandy Hook Bay the organic values were slightly higher than the inorganic values. For both Raritan and Sandy Hook Bays the nitrogen to phosphorous ratio was greater than 35 to 1. Relative to the typical phytoplankton ration of 16:1 (Redfield, 1934), the ratio in Raritan Bay would suggest that phosphorous is limiting to phytoplankton growth.

Fecal coliform values in the estuary indicated excellent water quality. NJ Water Quality acceptable standard for fecal coliform for bathing beaches is that the geometric average can not exceed 200/100 ml for all coastal stations and all ocean samples from 1500 ft to three miles from the shoreline. The acceptable standard for ocean stations within 1500 ft of the shoreline is that fecal coliform concentrations shall not exceed 50/100 ml. All stations in this estuary met the acceptable criteria for every season.

3.6 Impaired Water: 303d List

Section 303(d) of the Federal Clean Water Act requires states to identify waters that are not attaining surface water quality standards, despite the implementation of point and non-point source controls (NJDEP 1998). Waterbodies for which exceedances of SWQS numerical criteria have been documented and/or for which non-attainment of designated uses has been documented or are suspected are included on the Water Quality limited Segment List. This list is known as the 303d List since it is required by Section 303d of the Federal Clean Water Act. From this list, a TMDL will be developed for each pollutant of concern following the procedures for developing TMDLs in N.J.A.C. 7:15-7, adopted on May 5, 1997. States must then identify high priority waterbodies for which they anticipate establishing TMDLs (See Section 1.3) in the next two years. If, following this procedure, a waterway is found not to be impaired or unlikely to be impaired for a specific parameter, it will be de-listed for that specific use impairment through the next subsequent List.

The 1998 303(d) List was divided into three distinct parts: 1.) Waterways with Known Impairments; and 2.) Candidate Waters (Sub-Lists A and B). In Appendix 1 Tables 3.6-1 through 3.6-7 summarize the impaired waterways by watershed for WMA #12 as derived from the 1998 303(d) List.

3.6.1 Waterways with Known Water Quality Impairment (Sub-List 1)

Sub-List I waterways are presented in the tables in Appendix 1 and include:

- Waters whose listings are based on conventional pollutants (except for ammonia) and fecal coliform,
- Twenty-two lakes with confirmation of water quality problems through complete Phase 1 studies under the Clean Lakes Program,
- Waters with fish consumption advisories in place; and
- Assessments compiled through monitoring programs subject to modern QA/QC procedures.

This sub-list is considered to be the list of waters for which TMDLs are known or strongly expected to be needed based on current information (i.e., meaning that numerical or narrative criteria are exceeded or that a use is confirmed as being impaired, as required by Section 303(d) 1 of the Clean Water Act). DEP will continue to perform monitoring related to these data categories, and may revise the 303(d) List if conditions change so that more or fewer waters are confirmed as water quality-limited.

3.6.2 Candidate Waters (Sub-List II)

Sub-List II waterways include waters with some evidence of water quality problems but lacking sufficient information to confirm those problems. Therefore, a critical "next step" for all waters on the candidate list is supplemental monitoring. The Department does not consider these candidate waters as being "confirmed" for TMDL development until the results of the additional monitoring have been assessed. Such monitoring will be performed before or in step with the TMDL development schedule, so that each TMDL project is based on sufficient information. Based on the results of such monitoring, some waters will be identified as "water quality-limited," and therefore moved to the "Known" list as described above, and be subject to a TMDL. Other waters will be confirmed as not being water quality-limited, and that result will not be included in a subsequent 303(d) List. This sub-list is further divided into two parts (A and B) based on the strength of evidence for water quality impairment.

3.6.3 Candidate Waters (Sub-List IIA): Known Water Quality Impairment

Sub-List IIA waterways are presented in the tables in Appendix 1 and include waters exhibiting severe biological impairment. Their inclusion is based on a high expectation that such waters will exhibit water quality impairment. (These waters will often have physical and habitat impairment as well). This sub-list also includes waters where the nature of observed biological impairment strongly suggests the presence of toxic substances.

3.6.4 Candidate Waters (Sub-List IIB): Suspected Water Quality Impairment

Sub-List IIB waterways are also presented in the tables in Appendix 1 and include waters impaired by heavy metals and ammonia, as well as assessed public lakes (i.e., sources of impairment suspected) and waters exhibiting moderate biological impairment. These waters either lack extensive data or the available information is not a strong indicator of water quality impairment, but sufficient data or indicators exist that further analysis is warranted. Tables list lakes in WMA #12 assessed by the Clean Lakes Program as use impaired but the sources of pollution are not yet determined. Water quality data for many of these lakes are old, with assessments having been performed in the late 1970s and early 1980s. Other lakes in this listing are judged to be impaired based upon cursory surveys covering only a single year of data collection.

3.7 Surface Water Quantity

Any discussion of water quality must also take into account the impacts of water quantity, water supply and water withdrawal from a watershed. Prevailing management issues for water supply in WMA #12 have been laid out in *The New Jersey Statewide Water Supply Plan* (NJDEP 1996(a)(b)(c)) which clearly looks watershed-based management as the primary themes towards:

- Protecting the water quality of state water supplies;
- Strategically expanding water conservation and reuse efforts;
- Emphasizing sustainable strategies while ensuring water-related beneficial use;
- Developing additional water supplies, as necessary.

The State Water Supply Master plan (1996(a)), using a slightly different naming convention, lists two Water Supply Management Areas (WSMAs) in WMA #12. These include Water Supply Area No. 13 (i.e., the Manasquan River Watershed) and Water Supply Area No. 12 (i.e., including the remaining watersheds in WMA 12).

WSMA No. 13 (Manasquan) is in Water Supply Critical Area No. 1 where cutbacks in well withdrawals have been in place because of the depletion of aquifers and the threat of salt water intrusion. The Manasquan Reservoir began operation in 1990 and was developed to provide surface water for conjunctive use with existing groundwater supplies.

There are 118 Public Community Supply Wells in WMA #12 and seven (7) permitted surface water intakes (Figure 3.7-1 and Table 3.7-1) including three large water supply reservoirs: the Swimming River (i.e., Navesink), Manasquan (i.e., Manasquan - an off-stream pumped storage reservoir) and Glendola (i.e., Shark River) Reservoirs. The inter-relatedness of surface water and ground water quality/quantity in the Manasquan River watershed of WMA #12 may be important due to its location in the outer coastal plain physiographic province. In essence, sandy soils and high infiltration rates can result in high groundwater to surface water discharge volumes where surface water/ground water -

quality/quantity issues are closely linked and need to be monitored and managed in tandem.

4.0 Contributing Factors

Numerous point and nonpoint sources of pollution contribute to surface water quality conditions and trends; these factors are collectively called “contributing factors”. Point sources discharge from a pipe or a ditch and include regulated facilities. Nonpoint sources of pollution emanate from diffuse sources that are often dispersed and difficult to control. Nonpoint sources within WMA #12 may include stormwater and runoff from developed or disturbed lands; contaminated sites; improperly placed or malfunctioning septic systems; air deposition; landfill runoff and leachate. Physical, chemical and ecological processes can transport toxics, nutrients and pathogens to surface water, ground water, sediments and plants and animals.

4.1 Point Sources

As of June 1998 there were 51 regulated point sources (i.e., existing NJPDES Permit Nos.) in WMA #12 that discharge treated wastewater to surface water (See Figure 4.1-1). A number of the larger facilities discharge through pump stations and pipe lines to ocean outfalls where mixing and dilution is maximized in the receiving waters. Regulated point source discharges are broken down into major and minor facility types (Table 4.1-1):

- 9 Municipal wastewater permits (i.e., 6 minor and 3 major), typically a combination of municipal and industrial wastewater;
- 29 Industrial wastewater/industrial stormwater permits;
- 12 Petroleum clean-up permits; and
- 1 Non-contact cooling water permits.

These facilities are regulated by effluent limitations specific to the type of facility, the type discharge, or if necessary as a means to protect site specific water quality. For example, all municipal treatment plants at a minimum are regulated for oxygen demanding substances, total suspended solids, pH, oil and grease and fecal coliform. Effluent flow is usually monitored.

Also presented in Figure 4.1-1 are the locations of the NJPDES permitted Solid Waste Landfills (SWLs). Table 4.1-2 supplies additional information including closure status, waste types received and ownership. In WMA #12 there are 23 SWLs: 2 county, 2 federal, 8 municipal and 10 private. All are closed except for three: James H. James LF (Brick Twp.), Lertch (Wall Twp.), and Monmouth reclamation Center (Tinton Falls). There are also 6 Class B Recycling Facilities (Class B) in WMA#12 (Figure 4.1-1 and table 4.1-3).

4.2 Point Source Compliance

Information on permitting and enforcement actions for permitted facilities are reported annually by NJDEP in the Clean Water Enforcement Act Report. Recent enforcement actions taken by DEP on the non-permitted dischargers is summarized in Appendix 1, Table 4.2-1.

4.3 Non-Point Sources

Cahill Assoc. (1989) produced a comprehensive evaluation of nonpoint source pollution in New Jersey's coastal zone. The purpose of their review was to evaluate New Jersey's coastal permitting program and determine if there were innovative practices that the State could employ to improve coastal water quality. They found that a substantial portion of the observed water quality problem in the coastal waters was directly related to the pollutants conveyed by stormwater runoff. Cahill Associates also concluded that nonpoint source water quality loadings of various sorts was increasing and that these increased loadings are reflected in several parameters such as fecal coliform, nitrogen and phosphorus One of the major conclusions of the Cahill Associates Report was the need for improved monitoring of the coastal waters.

4.3.1 Land Use Sources

Built Lands comprise 49 % of the landuse in WMA #12 (Figure 2.3-1). The majority of these areas are aggregated in the north and eastern coastal areas although sections of the western watersheds (i.e., headwaters) contain built lands. Built land includes urban, suburban, industrial and commercial uses. Land development contributes to nutrient and toxic contamination from municipal stormwater and runoff, septic systems and higher flows at municipal treatment plants.

4.3.2 Stormwater Sources

Stormwater and runoff also negatively affects stream hydrology and aquatic habitat through erosion, flooding, and loss of healthy stream bed and corridor structure and ecological communities. Under the Sewage Infrastructure Improvement Act (SIIA) *N.J.S.A. 58:25-23 et seq.* inventories and maps of stormwater and sanitary sewer lines and systems have been generated for 94 coastal municipalities. From this inventory a GIS database has been generated geo-referencing storm water outfalls and storm water management basins (e.g., detention and retention basins). Figure 4.3-1 details this type of information for Deal Lake in Asbury Park where 67 separate stormwater outfalls discharge into this small coastal impoundment with subsequent discharge through one ocean outfall.

4.3.3 Impervious Surfaces

Additionally ground and surface water supplies will be withdrawn from aquifers and surface waters. The amount and location of impervious surface coverage can be used to indicate potential water quality problems caused by patterns of land development. Pollution and reduced ground water recharge begin to occur when 12 to 17% of the land surface is covered by impervious surfaces. Impervious surface cover analyses for watersheds in New Jersey are being developed. Agriculture, which can also be associated with non-point sources of pollution (e.g., nutrients from fertilizers, toxics from pesticides), accounts for 13% of the land use primarily in the mid-central region.

4.4 Known Contaminated Sites

There are 547 known contaminated sites identified in WMA #12 (See Figure 4.4-1). These sites are managed by different elements within DEP's Site Remediation Program (SRP) based on the type of site (e.g., underground storage tank, federal facility, etc.), and the funding source for cleanup (e.g., public vs. private). These sites have been also been classified into remedial groups based on their level of complexity (See Table 4.4-1). The 547 known contaminated sites in WMA #12 fall into the following classifications:

A: Emergency or single phase, short-term cleanup (none)
B: Single phase cleanups of – only soils (28 sites);
C1: Single source/single contaminants affecting both soil and groundwater (190 sites);
C2: Multiple sources/contaminants affecting soil/groundwater - moderate (271 sites);
C3: Multiple sources/contaminants affecting soil/groundwater - severe (36 sites);
C4/D: Superfund –severe and complex (20 sites); and
NA: Known sites not adequately assessed to rank (2 sites).

This classification of site complexity into different levels is based on the SRP's 1989 Case Assignment Manual. The intent of the remedial level determinations are to reflect the overall degree of contamination at a site recognizing that individual areas of concern may involve remedial actions of varying levels which are explained below.

Level A: An emergency action taken to stabilize an environmental and/or health-threatening situation from sudden or accidental release of hazardous substances. Appropriate remedial actions involving a single phase of limited or short-term duration.
Level B: A single-phase remedial action in response to a single contaminant category effecting only soils. May be a sub-site of a more complex case. Does not include ground water investigation or remediation. Examples of level B cases include, but are not limited to "cut-n-scrape"; surface drum removals; fences; temporary capping or tarping.
Level C-1: A remedial action, which does not involve formal design where source is known/identified. May include the potential for (unconfirmed) ground water contamination. Examples of C-1 cases are regulated or unregulated storage tanks containing gas or heating oil; septic tanks etc.
Level C-2: A remedial action, which consists of a formal engineering design phase, and is in response to a known source or release. Since the response is focused in scope and address a known, presumably quantifiable source, this remedial level is of relatively shorter duration than responses at sites with higher remedial levels. Usually involves cases where ground water contamination has been confirmed or is known to be present.
Level C-3: A multi-phase remedial action in response to an unknown and/or uncontrolled source or discharge to the soils and/or ground water. In this remedial level the contamination is unquantifiable (or presumed unquantifiable) and, therefore, no determinable timeframe for the conclusion of the remedial action is known.
Level C-4/D: A multi-phase remedial action in response to multiple, unknown and/or uncontrolled sources or releases affecting multiple medium which includes known

contamination of groundwater. In this remedial level the contamination is unquantifiable (or presumed unquantifiable) and, therefore, no determinable timeframe for the conclusion of the remedial action is known.
Level NA: Not Assessed.

4.5 Pesticide Usage

Pesticide use data are collected on a municipal basis and will be re-assessed on a watershed basis and summarized in the WC&A report.

4.6 Watershed Sources

4.6.1 Navesink River

Point Sources of Pollution
No wastewater dischargers are reported to be under enforcement actions by the NJDEP within the Navesink and Shark River watersheds at the present time. Willow Brook has in the past been reported to suffer from the contribution of both point and nonpoint sources. A number of industrial point sources combined with suburban/agricultural runoff and septic systems were all suspected causes of the elevated nutrients and bacteria found in the brook. The current status is not known. Also in the past, Imperial Oil Co. containing a hazardous waste site was affecting Lake Lefferts and Birch Swamp Brook with organics, metals and PCBs. The Seaview Square Mall has been built on an old dumpsite and was suspected of contaminating Deal Lake with metals and polynuclear aromatic hydrocarbons.

Nonpoint Sources of Pollution
Horse farms, construction activities, and urban runoff are believed to be the principal nonpoint sources of pollution in this region. These have brought about siltation, nutrient loading, and excess bacterial contamination in the local rivers. Bacteria from horse farms and urban runoff had contaminated many of the shellfish harvesting beds in the downstream reaches of these rivers.

In the Navesink watershed both agricultural and suburban construction activities have created severe pollution problems. Crop production and horse farming, especially the stockpiling of manure has resulted in excessive nutrients and bacterial loadings. In addition, depressed dissolved oxygen levels threaten the local fresh water fishery in the Navesink. Urban development impacts the Navesink; largely by contributing stormwater runoff and septic tank leachate, both of which are believed by local authorities to contribute to siltation, nutrient loading and oil and grease contamination.

As noted above, the Navesink River and adjoining Shrewsbury River produce almost the entire soft clam fishery for New Jersey and, as a result, the Navesink estuary has been the focus since 1981 of a major interagency regulatory effort to reduce nonpoint source bacterial pollution (NJDEP, 1993). In concert with this effort, the Federal Natural Resources Conservation Service is sponsoring a soil erosion and animal waste control project in the watershed. A comprehensive, coordinated management plan was implemented in 1986 to reduce bacterial loading to the estuary. Sources of contamination were attributed to a combination of stormwater runoff associated with residential development, agricultural waste and marina/boat associated pollutants. Management partnership plans were drawn up and proposed projects scrutinized to assure Best Management Practices (BMPs) for non-point source control were included in all design plans. The Navesink River was also designated a "Special Water Area" in the rules on Coastal Zone Management *N.J.S.A. 7:7E-3.1*, which provided an extra measure of protection. In 1997, as a result of these activities the shellfish classification for the Lower Navesink River was upgraded and approved for seasonal harvesting of shellfish for the first time in 25 years (NJDEP 1997).

4.6.2 Shrewsbury River

Point Sources of Pollution
No information available at this time.

Nonpoint Sources of Pollution
The Shrewsbury River is affected by many of the same problems that impact the other local waters. Agricultural runoff from croplands, pastures, and animal holding areas is believed to be contributing excess nutrients, silt, and bacteria to surface water. Horse manure at Monmouth racetrack had been contributing high levels of bacteria to the river; however, enforcement efforts by NJDEP in concert with the Monmouth County Health Department have significantly reduced this source. Increases in suburban and commercial construction in the watershed and runoff from storm sewers and suburban surfaces have sent excess silt, salts, nutrients, and oil and grease into the waterway. This has caused high water temperatures, low dissolved oxygen levels, and restrictions in shellfish harvesting. Some nonpoint pollution in the Shrewsbury watershed is also suspected as originating from septic systems and waste disposal sites.

4.6.3 Shark River

Point Sources of Pollution
No information available at this time.

Nonpoint Sources of Pollution
The Shark River watershed appears to be impacted more by suburban pollution sources and less by agricultural sources than the Navesink River watershed. Agricultural activity is suspected of contributing some runoff from pasturelands - resulting in nutrient and silt loads entering the waterway. In this watershed, road and housing construction, as well as urban runoff and landfills, predominate as the suspected principal nonpoint pollution sources. Local construction on roadways and housing are suspected of contributing to severe siltation and turbidity, especially in the headwaters. In addition, construction activities expose acid-producing soils, which, in turn, can cause a pH depression in local streams. Widespread suburban runoff from both suburban surfaces has sent excess silt, road salts and bacteria into the Shark River, its tributaries and lakes. Landfills and other forms of waste storage are also suspected sources of pollution in the Shark River. In the headwaters at Tinton Falls, volatile organics have been reported in the past to be leaking

into the local waters during rain. In Neptune City, underground waste storage tanks had been reported to be leaking petroleum products.

As mentioned earlier, Deal Lake is impaired by stormwater, sedimentation, poor sanitary quality and excessive aquatic macrophyte and algae growth. Restoration efforts began in 1989 and included public education and the planned construction of four sediment retention basins. Efforts at constructing the basins are still ongoing.

4.6.4 Manasquan River

Point Sources of Pollution

The Manasquan River and Marsh Bog Brook had in the past experienced significant point source loadings. These had contributed to excessive nutrients and, as a result, low levels of dissolved oxygen in some sections of these streams. In the Freehold Borough area, a number of industrial facilities discharged to tributaries of the Upper Manasquan. The Lone Pine Landfill, a Superfund hazardous waste site, is located in the headwaters of the river, which historically contributed pollutants (i.e., volatile organics and metals) to the river. The site is currently in various stages or remediation. In addition, the Bog Creek Farm site has been reported to have contaminated the North Branch Squankum Brook with volatile organics. As of 1994, all municipal wastewater facilities within the Manasquan watershed have been eliminated and their wastewater flows transferred to the Ocean County UA Northern facility for treatment and discharge to the Atlantic Ocean. The Manasquan estuary has only one remaining NJPDES permitted discharge, a pump-and-treat groundwater remediation system in Point Pleasant Beach.

Nonpoint Sources of Pollution

The Manasquan River watershed receives a wide range of nonpoint source pollutants. Sources include agriculture, waste disposal and suburban development. Here, as in other eastern coastal watersheds, bacterial contamination of waterways is a widespread and significant problem. In the Manasquan River itself, agricultural nonpoint source pollution impacts are reported to be largely centered in the region just east of Route 9. Here, croplands, pastureland, feed lots and animal holding areas have combined to cause nutrient loading, siltation, and high bacterial levels in the river. Housing construction within the downstream end is also contributing to siltation and turbidity problems, while moderate to severe levels of runoff from urban surfaces and road salting have led to salinity and nutrient loading. Within the estuary, the high concentrations of waterfowl have contributed to the buildup of bacteria (Monmouth - Ocean Counties, 1996).

Tributaries to the Manasquan received much the same types of nonpoint pollution, as does the Manasquan itself. Squankum Brook is suspected of receiving runoff from cropland, pastures, and animal holding areas. Marsh Bog Brook is suspected of being impacted by agricultural runoff from cropland and animal holding areas. Local landfills and septic systems are also suspected and known sources of pollution, respectively. DeBois Creek is known to be impacted by siltation from both road and home construction. Here, tree cutting during road construction has led to the destabilization of stream banks. DeBois Creek is also degraded by urban runoff. Lakes assessed in the watershed are experiencing high bacterial levels and eutrophication as a result of inputs from waterfowl and road runoff.

5.0 PRELIMINARY ASSESSMENT

5.1 Designated Use Assessments

Major potential use impairments in New Jersey's coastal waters include restrictions on bathing, restrictions on shellfish harvest and inability to support natural populations of aquatic organisms (aquatic use).

5.1.1 Swimmable Support Status

Agencies that participate in the Cooperative Coastal Monitoring Program (CCMP) perform sanitary surveys of beach areas and monitor concentrations of bacteria in nearshore coastal and estuarine waters to assess the acceptability of these waters for recreational bathing (Appendix 3 (b)). These activities and the resulting data are used to respond to immediate public health concerns associated with recreational water quality and to eliminate the sources of fecal contamination that impact coastal waters. As part of this program, DEP routinely inspects the 17-wastewater treatment facilities that discharge to the ocean. DEP also performs aerial surveillance of New Jersey nearshore coastal waters and the Hudson-Raritan estuaries to observe changing coastal water quality conditions and potential pollution sources. Participating Health Agencies closed 10, 18 and 3 ocean beaches in 1996, 1997 and 1998 summer seasons respectively. Detailed beach closing information, including the specific beaches closed (i.e., in WMA #12 and statewide) and reasons for the closings for this period are presented in Appendix 3 (c).

5.1.2 Aquatic Life Designated Use Status

Freshwater aquatic life designated use status is based on benthic macroinvertebrate monitoring data. Based on data collected through 1995, published in the 1996 Statewide Water Quality Inventory Report, 4 stations out of 43 (9%) in WMA #12 showed no impairment, 30 (70%) showed moderate impairment, and 9 (21%) showed severe impairment. Additional benthic macroinvertebrate data have been collected, and these will be incorporated into future assessments of water quality in WMA #12. Note: See Biological Assessment Table 3.2-1 (Appendix 1) for details regarding macroinvertebrate assessments within sub-watersheds within WMA #12.

Monitoring by the NJDEP's Bureau of Marine Water Monitoring has measured nitrate levels in the States coastal waters since 1989. One of the results of this monitoring has been to highlight the degree to which nutrient enrichment is occurring. However, despite the magnitude of these nitrate loads, there does not appear to be a use impairment associated (i.e., eutrophic conditions or low oxygen levels).

5.1.3 Shellfish Harvest Designated Use Status

A major use impairment in New Jersey's coastal waters that is related to NPS is restrictions on shellfish harvesting. A review of the information generated by the NSSP (see above) over the past 25 years shows that a great deal of effort has been spent eliminating point sources of pollution from the State's back bay waters through regionalization of wastewater management. As a result, many of New Jersey's estuarine waters have no point sources of wastewater discharge. The State's coastal waters have improved considerably as a result of this effort. In spite of these improvements, portions of these same waters still have some restrictions on shellfish harvesting due to poor water quality (Figure 5.1-1). In the absence of point sources of pollution, this use impairment is clearly related to NPS pollution. There are numerous potential sources for this NPS pollution that would include boating, stormwater runoff, wildlife populations and failing or illegal septic systems. Improving the quality of stormwater however, and/or reducing the amount of stormwater runoff has a high probability of success of removing a use impairment in certain waters in New Jersey (Connell, 1997).

5.2 Designated Use Assessment by Watershed

5.2.1 Navesink River – Shrewsbury Rivers (Estuary)

Aquatic life designated use support in the Shark River is a mixture of partial support and nonsupport. Shellfish growing waters in this region are classified as Special Restricted (further treatment required) for harvesting except in the lower estuary where Seasonally Approved (Nov.–Apr.) harvesting is allowed (Figure 2.2-1). No current sanitary data exists for assessing the primary contact support within the freshwater portions of the Navesink River.

5.2.2 Shark River

Aquatic life designated use support in the Shark River is a mixture of partial support and nonsupport. Shellfish growing waters in this region are classified as Special Restricted (further treatment required) for harvesting. No current sanitary data exists for assessing the primary contact support within the freshwater portions of the Shark Rivers.

5.2.3 Manasquan River

Swimmable support status is based on fecal coliform concentrations in streams. Local health officials assess bathing beaches at lakes and data is supplied to NJDEP. However, this data was not in a readily available format for performing trend analysis precluding a review of swimmability support status at these beaches. The Manasquan River at Squankum will not support the swimmable (primary contact) designated use because of elevated fecal coliform levels.

These streams in general will either not support or only partially support the aquatic life support designated use based upon macroinvertebrate assessments. The exceptions to this are Stan and Squankum Brooks in Howell Township and the lower portion of Mingamahone Brook in Squankum, all of which fully support the use.

The tidal Manasquan River is Special Restricted (further treatment required) for the harvesting of shellfish and Prohibited above the Route 70 Bridge.

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